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PROBLEMS OF SCIENCE EDUCATION
IN AFRICA: SOME ANALYSIS AND
PROPOSITIONS

REWORD

The Human Resources Research Centre (HRRC), which is based in the University of Zimbabwe's Faculty of Education, opened in January 1988. The HRRC's decision to initiate a Working Papers series was based on the realization that there is a dearth of published research and policy-related material, focusing on the special needs of sub-Saharan Africa. In particular, there are relatively few materials available for instructional use in post-graduate training programmes in the region.

Papers in this series are intended to disseminate preliminary research findings, to stimulate thought and policy dialogue and to provide instructional materials for use in post-graduate programmes. The series includes works which, in the opinion of the HRRC Editorial Board, contribute significantly to the state of knowledge about human resources issues. Working Papers are widely circulated in Zimbabwe and the sub-Saharan region. Items in the series are selected by the Editorial Board. The contents of individual papers do not necessarily reflect the positions or opinions of either the University or the HRRC.

Dr Alonge's paper addresses the critical issue of science education in Africa and considers indicators of failure and success and the factors that may contribute to observed patterns.

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Victor Levine
HRRC Coordinator
June 1989

OBITUARY

It is with great sadness that we initiate the Working Papers Series. The first paper in this series was written by our late colleague Dr E I Alonge, who served as a Visiting Senior Lecturer in the University's Department of Curriculum Studies in 1988. Dr Alonge's untimely death is a great loss to us all.

Dr Ebenezer Ilori Alonge was born at Isua in Akoko Division of Ondo State, Nigeria. After graduating in Chemistry with a Second Class (Upper Division) degree in 1974, he was appointed a Graduate-Assistant in the Faculty of Education, University of Lagos in August 1975. Between 1975 and 1977, he obtained two masters degrees – an M.Ed from the University of Lagos and an M.Sc in Chemical Education from the University of East Anglia, Norwich, U.K. Subsequently, he earned a Ph.D in chemical Education from the University of East Anglia in October 1979.

On return to Nigeria, Dr Alonge was appointed a lecturer in the Department of Curriculum Studies, University of Lagos, where he rose to become a Senior Lecturer in October 1983, a post he held until his untimely death on 22 June 1988. He was aged 41. Dr Alonge was a visiting Senior Lecturer at the University of Zimbabwe in 1987. He was an erudite scholar, credited with a number of scholarly publications in workshops and conferences and his participation in every activity of the Department of Curriculum Studies, University of Zimbabwe will be sadly missed.

As a person, Dr Alonge was God-fearing, charming and good mixer. May his soul rest in perfect peace.

Dr Hodzi
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PROBLEMS OF SCIENCE EDUCATION IN AFRICA SOME ANALYSES AND PROPOSITIONS

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INTRODUCTION

Generally, problems or progress of science education in Africa is discussed in terms of enrolment statistics, teacher\pupil ratios and facility inventory such as number of classrooms, laboratories, availability of texts, etc. All too often, the said statistics is used to justify performances in examinations. Thus, a Government that is able (if possible) to meet the requirements defined within the said statistics as adequate would consider its job done. As most governments are often not able to meet the optimal ratios, science education in Africa has been and remains an important field in which considerable government efforts have been directed. Some of such efforts often code named as TEMPORARY, EMERGENCY, OR CRASH PROGRAMMES have often made some impact while others remain no more than footnotes for literature use. It is common knowledge that neither the sporadic short term measures nor the conventional long term solutions in current use seem to hold promise for anticipated rate of development in science education. It does appear that beyond the enrolment

statistics and performances in examinations are deep-seated problems too frightening to confront and yet too serious to ignore.

In this analysis, science education is pictured in a state of tension. The conflicting variables are analysed. Essentially, science education practice is shown as having ignored the context. Context variables have hitherto been ambiguously sheltered under language and culture, which in some way is deemed immutably anti-science. The analysis shows the context variable as wider and sufficiently potent for productive science education provided we make attempts to be honest to the goals of science. The propositions advanced are based on how to accommodate salient learning features which have hitherto been neglected. It is hoped that the propositions will appeal to practitioners, and researchers, if not in whole at least in part.

HISTORY AND GROWTH OF SOCIAL SCIENCE IN AFRICA

Education as is practiced today in schools was introduced in the nineteenth century by Western countries. Science education however did not feature on the curriculum until the beginning of the twentieth century. The science subjects were introduced in the secondary schools and the objectives were largely tied to the production of technical manpower to assist in medicine, agriculture, surveying, engineering etc. Programmes to train teachers of science in Nigeria did not commence until about 1933 (Fafunwa 1974). If the belatedness of the introduction of science is a sore point, the slow rather hesitant provision made for training teachers for it, still apparent today, appears to be a colonial heritage. Another structurally significant factor had to do with who in the societal structure was introduced into reading science. Unlike in Europe, where school science devolved from the activities of leaders of thought in logic, science and engineering, science was introduced into the secondary schools, the very apex of the school system at that time. As the educational system grew, lengthening to higher education and broadening in secondary level, the teaching of science subjects grew in those directions. It grew rather poorly in the direction of primary schools

and has hardly been considered seriously as a subject for adult education in adult literacy programmes.

Two major consequences have emerged from this developmental path. One is that the larger adult community had remained cut off from the language, content and purpose of science. It can be argued that this is true of all western education packages available in Africa. So too can it be demonstrated that the adult community has since made tremendous (if undocumented) contributions to history, literature, orator, art, music etc. The second is that science and its related concerns has been conferred with an elite status, an enviable target which has attracted some of the best brains and remains a tempter for some of the least able. The motivation to belong to this group is very high. The human efforts and financial investment that is often made both by the poor and not so poor is extensive and to the point of sacrificial self denial. Yet the results, year after year, seem to bring more gloom than cheers. While history itemises what was done and what was not done, it also shows that it would take quite some effort to make changes.

RESOURCES V CONTEXT

Several people (practitioners, researchers and administrators) who are familiar with the problems of science education in Africa would cite lack of adequate science teachers and teaching facilities as the most serious problems to overcome. This, I label as the resource problem, human and material. Others still would argue that socio-cultural factors of language and irrelevance of content are at par or indeed seem greater than the problem of resources. I label this second category of problems as one of context. That both resources and context contribute immensely to science achievement is not in doubt (Comber and Keeves, 1973; Whitfield, 1979). The particular way in which each contributes is difficult to analyse within the scope of this paper. It is desirable however to point out that contrary to widely-held views that socio-cultural patterns in Africa which puts adult over learners as anti-scientific however, achievement research findings actually encourage teachers to be "sufficiently demanding, structured and authoritative in their style" (Whitfield, 1979).

The truth is that the dynamics of what a culture goes through to make children learn could be complex. The larger the number of variables in a learning context, the more difficult it would prove to reduce difficulties encountered to linear relations. Admittedly, adult authority held sway in traditional Africa. To posit that in Africa of the seventies and eighties is to ignore the realities of "things fall apart" in family structure, urban migration, deserted rural areas, youth culture and the redefinition of social boundaries as a result of socio-political transformations, of which Africa has its fair share. For good or for ill, fast or slow, these changes are taking place, perhaps regrettably, at a rate hardly any government can control. Most teachers in Africa today know that their authority of yesteryears are no more. When however the students in the classes they teach listen with minimal inquisitive tendencies, we need a closer re-examination of the situation. Otherwise, we might persist in using outdated concepts to rationalise the failure of today. What then are the other aspects of the context deserve further analysis? This shall be treated later in this paper. It does deserve being restated that most solutions professed in the past to the problems of science education by frequency count seem to focus only on the resource end. The consequence in planning for science education is in the direction of supplying more and more of the items on the existing inventory - buildings, teachers, equipment, books, benches etc.

Amongst the notable exceptions to resource oriented solutions are the work of SEPA (Dyasi, 1972) and the [Ife Six Year Primary Project, see Fafunwa, 1975]. Although the legacies of SEPA reflect in the several science curricula produced in several parts of Africa in the last two decades, it cannot be said that its mission was fulfilled. The notable findings of the Ife Six Year Primary Project, although not specific to science alone, are already part of history as they gather dust wasting or waiting for further development. A point to observe is that the more we pursue fulfilling inventory requirements in science, the less our currency actually produces. Hence, what we are capable of supplying is drastically short of what we need. Notable efforts in the realm of low cost equipment have been made by UNESCO, Commonwealth Education Division and African governments, e.g.

ZIM-SCI in Zimbabwe, in Sierra Leone, Nigeria and Kenya. The issue is not whether these had been successful according to one evaluation report or the other because it would appear that we would continue to require low cost equipment as a supplement for a considerable length of time. The crux of the problem is that the scope of the need far exceeds what equipment can satisfy. What is required is for us to reconceptualise needs on the basis of clearer parameters that involve more than enrolment and teacher\pupil ratios.

SUCCESS V FAILURE

An index for judging the performance of the educational system in Africa is the pass rate in the school system. The Z.J.C. result in Zimbabwe for General Science and English is shown in the table below

Extracts from Z.J.C. results (1985)

SUBJECT	English	Science	Maths
No of candidates	148 670	124 050	122 461
% in Pass grade (1-6)	54.1	13.7	12.9
% failures	45.9	86.3	87.1

Table adapted from *Annual Report of the Secretary for Education* (1985). Government Printer p. 22.

The result tabulated here is not strange to those who are familiar with the trends in performance in science, particularly in several African countries. Results at higher levels of the secondary school system, i.e. G.C.E. O-level and A-level are in no wise better except perhaps for the A-level where only fairly able candidates enrol. Two points deserve attention for the purpose of this paper: (i) that the failure rate is high and (ii) that the success rate in English is far higher than in science and maths. In respect of the latter we ask two questions: is it feasible that the English language in which the candidates fared much better would account in the main for the woeful performance in science? Could it be that the language level in science is higher

than the linguists demand of learners? This author proposes that further examination of parallel data be made to illuminate these questions. The possibility that we exaggerate the status of language barrier and undermine some other factors might not be remote.

In respect of the poor performance we ask the following questions:

- What encouragement do we give to those who pass? – minimal.
- What intervention programmes do we operate or institute for those who fail? – hardly any.
- How much responsibility do we accept for their failures? – hardly any.

On the premise that we have no reason to believe that the pupils are as poor as the results in science reflect, it can be safely argued that we are yet to provide them with the best that they should learn and how to learn it. As of now, it would appear that where we have not cued the learning process for them wrongly, we have cued it poorly. What are the correct cues? These are the issues of context.

LANGUAGE VERSUS LEARNING

Normally, we speak of language and learning, accepting that one facilitates the other. It is the possibility that language would counter learning that we want to explore. Squarely, the issue is one of second language at its simplest or multi-lingual situation in a learning context. Two scenarios are proposed for illustration:

- A bilingual expatriate for whom English is a second language teaching science in Bonda Mission, Zimbabwe.

The class first language profile could be b% shona, c% Ndebele, d% Swahili, e% Portuguese, f% Hindu, such that $b + c + d + e + f = 100\%$. A science teacher in this context hardly notices language barriers. Suppose it does occur, how often would it be?

- A Nigerian chemistry teacher whose mother tongue is Ifan. He teaches in a Lagos school.

Suppose the language profile of his chemistry class is c% Yoruba, d% Igbo, e% Edo, f% Isoko, 2% Ushobo, h% Ibibio, i% Boki, j% Igalla. In this case it is a bilingual Nigerian teaching in his own country and yet his own mother tongue may not be represented amongst his students. When this author taught science in Ikom in Cross River state of Nigeria, four or five linguistic groups were represented in my classes and my mother tongue was not in any of them. Although it was not obvious that language barriers were encountered in the course of teaching, it was often observed that the informal language of communication amongst the pupils was "pidgin". Pidgin is a form of adulterated "English" that is widely used in Nigeria. It is generally known however that when teachers find it necessary to do so in the course of instruction, they do use pidgin or mother tongue (Soyibo, 1979). Seemingly extreme examples of the language problem have been chosen to illustrate perhaps the most complex situations. There are African nation states with monolingual or bilingual heritage e.g. Sesutu in Lesotho; Swati in Swaziland, Sestwana in Botswana, Ndebele and Shona in Zimbabwe. The Ife project demonstrated the efficacy of mother tongue in a part of Nigeria. A most instructive finding is the degree of confidence which the learners were said to have attained after going through the primary education using a Nigerian language (Yoruba) as a medium of instruction. In that case, English became a subject rather than a medium of instruction. It is perhaps in the matter of confidence that was gained that the attraction exists for the use of any language with which the learner feels most relaxed. Confidence is critical for questioning and questioning is critical for science. It certainly deserves to be questioned whether science teaching need be restricted to using a language in which neither the teacher nor the pupils

can operate an elaborated code. Exploration of the use of complementary language deserves support. The question is how do we go about it?

"EXPERIENCE" V "EXPERIMENT"

For the purposes of this paper, experience is defined as what a learner goes through in physically observing a phenomenon either from the viewpoint of cause, effect or both. It can be as rudimentary as seeing sugar "disappear" in water, as boring/exciting as watching a candle burn or determining the time interval between the occurrence of lightning and thunder.

Experiment on the other hand is the tested wisdom of several years of science which have become routine for learners and teachers. They are the exemplars of scientific illustrations, supposedly selected for their conceptual strength. This perhaps partly explains why some experiments have remained in texts for decades.

Ideally, experience and experiments ought to dovetail. Indeed, experience ought to provide the cognitive artefacts for formation of hypotheses and experimentation. However, regrettably, teachers are impatient with "experience". The 'tyrant' behind the impatience is examinations. They thus seek refuge in the desire for 'quick coverage' and indicate preference for practical work/experiment. In practice, practical work gets relegated for lack of resource and the only thing that thus gets done is "quick coverage". The students therefore lose out on experience and on practical work! The question is: if we cannot get practical work or "experiments", what about "experience"?

It can be shown that a good proportion of what we want to illustrate experimentally has its counterpart in "experience". If it were not so, it would not be science! An important bonus from activities of experience is that it leads to increased verbalization on the part of learners. Verbalisation is a powerful feature for detection and correction of misconceptions (Alonge, 1987); formulation of hypotheses, experimentation and deriving generaliza-

tions. In addition, this approach is likely to utilise the immediate context and environment without difficulty.

TEACHER STRAINING V TEACHER TRAINING

A few years ago, the terminology - teacher burn out was coined to describe the fact that teachers were being overworked. That was in the U. S. A. In Africa, many other problems tend to obscure the fact that teachers are straining. Science teachers in particular, for reasons earlier stated have to cope with large classes and several school teaching periods. When they are not straining over a revised curriculum, they might be contending with a new examination board or regulation on assessment. That teachers are strained is not new, but that they are perhaps least assisted in Africa is hardly in doubt. If science teachers are not considered exceptions in this, the situation nevertheless warrants attention on its own merit.

It is the parallels and contrasts in straining while training as well as while teaching we now focus. The question to answer is what does the teacher learn in training?

Simply put, he learns content and methodology. The support subjects are drama from Psychology, Sociology, Administration and Educational Technology.

Experience shows that:

- organisation wise, these courses are hardly different from the pattern that was followed in the developed world some twenty years ago;
- the courses are not sufficiently integrated to produce the practitioner that is needed;
- they are lacking the resolve to make the context the critical issue in learning science.

Nevertheless, the trainees are strained partly on the demand of content, a good proportion of which they might NEVER use.

They are strained by the demands of experts in several fields through examinations, assignments, project work, teaching practice etc. However, when they have graduated, and assume duties in schools, they discover that they have not been trained to:

- teach large classes
- negotiate around learning barriers in bilingual or monolingual contexts;
- structure learning experiences around events, phenomena, episodes that convey science without the format and input of a textbook and
- interpret and implement new curricula although they are accredited as among the most potent agents of change. Admittedly, these are mammoth tasks and are often avoided for their size. Some would brand it as 'Woolly' and superfluous. Certainly given a commitment to a straight forward traditional routine, these are no linear tasks. Perhaps it is within its 'wooly' nature that the crux of our problem lies.

Science teacher education programmes need look at these issues critically even if different approaches must be adopted towards them. Some propositions are made below.

PROPOSITIONS

There are two parts to it. One concerns what we make the trainees do to master the context and be confident at doing it. The other concerns what we give them to read, in the course of training both as part of content and methodology courses. This certainly is not exhaustive. The goal is to stimulate awareness and thoughts in similar directions.

A. Fieldwork in context

Trainees must observe children at work, play and compile profile of:

- languages spoken;
- sociometric characteristics of groups of learners;
- Study and take frequency count of science related episodes or phenomena in their play;
- Structure in writing for critique and use learning experiences involving scientific phenomena;
- highlight variables, explanations, hypothesis and design experiments.

Unless it can be shown that such activities have been undertaken and it failed the limits of its adequates and possibilities can only be figured through trials.

B. What trainees must read more is 'Science' and less 'content'

Our trainees must be made to develop a favourable attitude towards reading. In particular they must read more and more science. As a rule, several supplementary texts on science suitable for the age group of children they are preparing to teach must be ready by then. It should form a course of an important rating. This course must be distinguished from a course that spreads them rather thinly over electives in a faculty of science. If the programme provides for that as well, the better. The argument for supplementary science reading course is as follows. The issue is we have to make a choice. A choice between a graduate biology teacher who struggles over the concepts in genetics and biology teacher who can confidently lead a class of forty on a field trip in the school garden create several instruction lessons from the field trip.

We have to make a choice between a graduate physics teacher who would rather wait for a sociometer to complete his lessons on round or one who would seek options from within the school planks, wires and nails or maturate children to bring a four

sound instruments from the community, or use UNESCO sourcebook of science to make his lessons real.

We have to make a choice between a chemistry teacher who is scared of introducing titration because of 'mole concept' and one who recognises titration as a tool in volumetric analysis, one of several types of analysis in chemistry.

As of now, we tend to produce teachers who for no fault of theirs [they are strained, not trained] are perhaps sure of the 'content' but certainly far from the context. We tend to leave to chance the emergence of science teachers who will fulfil our dreams. The least that can be said about this is that it is an omission which can be corrected.

It can be said that the type of science teacher we wish to train is needed world wide and to some extent exist everywhere. In the developed world for instance there certainly would be many more of such teachers than in the third world. Whatever the other teachers lack to provide such a creative atmosphere is more than compensated for by numerous learning activities and resources in and out of school. For now, the teacher in Africa's only technologist for this purpose, we must equip him with the techniques.

CONCLUSION

Science education in Africa has received considerable attention in the last few decades. Whether the attention given parallels the level of need is certainly a different subject. However, considerable problems remain unsolved. This, it would appear was created by the extent to which the context has been glossed over, perhaps in the anxiety to 'develop fast'. Resources were concentrated and continue to be directed at the readily purchasable learning resources. In a way, it could compare with erecting a structure on an inadequately studied terrain. Perhaps this is rather harsh, but the extent to which our aspirations have

been dashed not only evidenced in failure rate but in the scientific development that is yet to come is depressing.

The dichotomies that have been used to illustrate the ills of the system are intended to sharply focus on the variables to examine. It is suggested that the options available to us can be meaningfully pursued through reconceptualisation of the science teacher education programmes. The seemingly contentious issue of language does not appear to be one deserving of controversy but rather of one for widespread experimentation. Good enough precedents exists for us to draw inspiration from. The idea contained here are commended to all who share concern over the subject both for its meaning and urgency.

Talking of urgent issues in Africa, I recall an anecdote. I was once assigned with two other persons to serve on a Committee to review a programme within a department. At the end of the second meeting of the committee, we had agreed on who would do what in respect of the terms of reference. Specifically, we were to independently design instruments for the Committee to critique. When I asked the Chairman of the Committee when the deadline for submitting the instrument was, his remark was "Everything about Africa was required yesterday!" How true! An irony in contemporary African experience is that the problems we fail to face today never go away. Often, it costs us much more when contemplated tomorrow.

REFERENCE

Alonge, E.I. (1987). Updating teachers in Science: Matching goals and needs analysis. Commissioned paper presented at Regional Workshops on "learning difficulties and teaching strategies in Secondary School Science and Mathematics, 8-11 December 1987, Gaborone, Botswana.

Comber, R. and Keeves, P. (1973). Science Education in Nineteen Centuries. An IEA Study Report.

Dyasi, H.M. (1972). The Science Education Programme in Africa. In J.A. Ponsioen, (ed.), Educational innovations in Africa: Policies and administration Institute of Social Studies, Hague.

Fafunwa, A.B. (1974). *History of Education in Nigeria*. London: London.

Fafunwa, A.B. (1975). Education in the mother-tongue: A Nigerian experiment: the six-year (Yoruba medium) project at the University of Ife Nigeria. *West African Journal of Education*, XIX, 2, 213-227.

Ministry of Education. (1986). *Annual Reports of the Secretary for Education*. Zimbabwe.

Soyibo, K. (1979). The role of Nigeria Integrated Science Project in the learning of Science with particular reference to biology. Unpublished master's thesis, University of Leeds.

Whitfield, R.C. (1979). Educational Research and Science Teaching. *School Review*, 60, 212, 411-430.

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